Claims

1. A process for the removal of multivalent metal cations from an aqueous system, wherein said aqueous system is treated with a high molecular weight non-ionic surfactant comprising anionic groups or salts thereof, preferably terminal anionic groups and salts thereof, wherein said high molecular weight non-ionic surfactant comprising anionic groups or salts thereof is represented by formula A or formula B:

$$P_pR - P- [A]_n - [B]_m - [A]_n-P - RP_p \qquad (A)$$

$$P_pR - P- [A]_n - [B]_m - P - RP_p \qquad (B)$$

wherein:

P is a mono-valent oxygen containing anionic group or a salt thereof selected from the group consisting of oxides of carbon, sulphur and phosphorus;

p is in the range of 1 to 4;

R is a linear or branched, saturated or unsaturated C_2 - C_{12} alkylene group;

A is ethylene oxide;

B is propylene oxide;

n is in the range of 5 to 1000; and

m is in the rage of 5 to 1000.

2. The process according to Claim 1, wherein the oxides of carbon, sulphur and phosphorus are selected from:

$-C(O)O^-X^+$;

$-S(O)_q-O^-X^+$ wherein q is 1 or 2;

$-P(O)(O^-X^+)_2$;

$-P(O)(H)-O^-X^+$;

$=P(O)-O^-X^+$; and

$=P-O^-X^+$

wherein X is independently selected from hydrogen, an alkali metal, an ammonium group NR'_4^+ wherein R' is independently selected from hydrogen or linear or branched C_1-C_4 alkyl groups, or two X's are an alkaline earth metal.

3. The process according to Claim 1 or Claim 2, wherein the groups P are terminal mono-valent oxygen containing anionic groups or salts thereof.

4. The process according to Claim 3, said surfactant being characterised by the following general formula (I) or (II) or (III):

$$X^+O^-(O)C\text{-}R\text{-}C(O)\text{-}O\text{-}[A]_n\text{-}[B]_m\text{-}[A]_n\text{-}O\text{-}(O)C\text{-}R\text{-}C(O)O^-X^+$$

(I)

$$X^+O^-(O)_qS\text{-}R\text{-}S(O)_q\text{-}O\text{-}[A]_n\text{-}[B]_m\text{-}[A]_n\text{-}O\text{-}(O)_qS\text{-}R\text{-}S(O)_qO^-X^+$$

(II)

$$Z\text{-}R\text{-}Z\text{-}[A]_n\text{-}[B]_m\text{-}[A]_n\text{-}Z\text{-}R\text{-}Z$$

(III)

wherein:

X is hydrogen or an alkali metal, preferably lithium, sodium or potassium, or an ammonium group NR'_4^+ wherein R' is independently selected from hydrogen or linear or branched C_1-C_4 alkyl groups, or two X's are an alkaline earth metal, preferably magnesium or calcium;

R is a linear or branched, saturated or unsaturated C_2 - C_{12} alkylene group;

A is ethylene oxide;

B is propylene oxide;

n is in the range of 5 to 1000;

m is in the rage of 5 to 1000;

q is 1 or 2; and

wherein Z is independently selected from phosphonate or phosphinate.

5. The process according to claim 3, said surfactant being characterised by the following general formula (IV) or (V) or (VI):

$$X^+O^-(O)C\text{-}R\text{-}C(O)\text{-}O\text{-}[A]_n\text{-}[B]_m\text{-}O\text{-}(O)C\text{-}R\text{-}C(O)O^-X^+$$

(V)

$$X^+O^-(O)_qS\text{-}R\text{-}S(O)_q\text{-}O\text{-}[A]_n\text{-}[B]_m\text{-}O\text{-}(O)_qS\text{-}R\text{-}S(O)_qO^-X^+$$

(VI)

$$Z\text{-}R\text{-}Z\text{-}[A]_n\text{-}[B]_m\text{-}Z\text{-}R\text{-}Z$$

(VII)

wherein:

X is hydrogen or an alkali metal, preferably lithium, sodium or potassium, or an ammonium group NR'_4^+ wherein R' is independently selected from hydrogen or linear or branched C_1-C_4 alkyl groups, or two X's are an alkaline earth metal, preferably magnesium or calcium;

R is a linear or branched, saturated or unsaturated C_2 - C_{12} alkylene group;

A is ethylene oxide;

B is propylene oxide;

n is in the range of 5 to 1000;

m is in the rage of 5 to 1000;

q is 1 or 2; and

wherein Z is independently selected from phosphonate or phosphinate.

6. The process according to Claim 4 or Claim 5, wherein X is hydrogen or an alkali metal, preferably sodium or potassium.

7. The process according to any one of Claims 4 - 6, wherein R is a linear and saturated C_2 - C_6 alkylene group.

8. The process according to Claim 7, wherein R is ethylene.

9. The process according to any one of the preceding Claims, wherein n is in the range of 10 to 100.

10. The process according to any one of the preceding Claims, wherein m is in the range of 10 to 100.

11. The process according to any one of Claims 1 – 10, wherein said process comprises decreasing the hardness of said aqueous system

12. The process according to any one of claims 1 – 11, wherein said process comprises an industrial or a domestic wash process.

13. The process according to any one of Claims 1 – 12, wherein the temperature of said aqueous system is 0 - 200°C.

14. A process for the removal of multivalent metal cations from an aqueous system, wherein said multivalent metal cations are contacted at a first temperature with and thermo-reversibly bonded to a high molecular weight non-ionic surfactant comprising anionic groups or salts thereof, preferably terminal end groups or salts thereof to form a cation-surfactant complex, and wherein said cation-surfactant complex is subjected to a second temperature, the second temperature being lower than the first temperature, to release said multivalent metal cations from said high molecular weight non-ionic surfactant comprising anionic groups or salts thereof, preferably terminal anionic groups or salts thereof.